The Incidence And Occupational Outcome Of Overuse Anterior Knee Pain During Army Recruit Training

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ABSTRACT

Objectives

To determine the incidence and occupational outcome of overuse anterior knee pain (AKP) in Army recruits undergoing basic training.

Methods

A prospective cohort study of 1008 Army recruits. Recruits underwent the 12-week phase 1 training program. Cases of AKP were captured through self-presentation of pain at a primary care medical centre. All recruits medical records were reviewed on leaving training and any other lower limb injuries were recorded for comparison with the AKP group. Training outcomes in terms of medical discharges (MD) and discharges as of right (DAOR) i.e, voluntary discharge, were recorded along with training days lost (TDL) and whether a recruit had been held back in training (BS).

Results

8.75% (95%CI: 6.93 – 10.57) of recruits reported to the medical centre with AKP. Of these more than half were referred to see a GP and the majority were from patients with no previous history of AKP (91%, 95% CI: 85.2 – 97.5). The median TDL per AKP case was 3 days (IQR: 3-5 days). The AKP group had a significantly higher ($p<0.01$) MD rate (12.5%) than the lower limb injury group (3.3%; 95% CI diff: 1.1 – 17.2%) and the baseline rate of all other recruits (2.5%; 95% CI diff: 2.3 – 17.7%). The majority of AKP cases occurred by week 4 (median) of training (IQR: 2.2 – 6.4).

Conclusions

There was a high incidence of AKP, and while the short term prognosis appears relatively good in the majority of cases as reflected in the median TDL, a large minority were medically discharged and held back in training. Further work should examine methods of reducing the disease burden of AKP in the Army, addressing areas such as aetiology, prevention and treatment.

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Introduction

British Army recruits undergo an initial 12 week physically arduous training program. For some individuals this represents a major increase in physical demand and causes training injury and attrition. A previous study of British Army recruits showed an overall injury incidence of approximately 40% (1). Jones *et al* (1993) reported the incidence of lower limb injuries in male US Army recruits to be 37% (2). A more recent study of lower limb injuries in Danish service recruits reported an incidence of 28% (3). Previous studies in non-UK military recruit samples have reported the incidence of AKP at 5-15% (2,4-6). In a 2-year prospective study of 480 physical education students, the incidence of patellofemoral pain syndrome (PFPS) was 7 and 9% for males and females respectively (7). Other studies have shown the knee to be the most common site for overuse complaints in runners (8,9). These studies suggest that the incidence of AKP may be high in British Army recruit training, but this has not previously been quantified.

The term anterior knee pain is used to describe all symptoms of pain around the front of the knee, which may be caused by a number of conditions such as patellar tendinopathy and patellofemoral pain syndrome (10). The prognosis for most new cases of AKP following non-operative treatment has been described as good, although a proportion of sufferers have persistent symptoms which may limit their activity levels (11). However, out of all training injuries, AKP is the biggest cause of medical discharge from Army recruit training (12). Furthermore, the impact of AKP on other occupational outcomes such as training days lost is unknown and most of the information on AKP in Army recruits comes from retrospective studies (12).

Data presented in this paper are from a large prospective cohort study into the epidemiology and biomechanical risk factors of AKP in Phase 1 recruit training. The aim of this analysis was to quantify the incidence and occupational outcome of AKP in British Army recruits undergoing basic training.

Methods

Ethical approval was obtained from the Defence Medical Services Clinical Research Committee. All participants were verbally briefed about the study aims and procedures

and gave written informed consent. A prospective cohort study was undertaken of 1008 Army recruits (48 female) entering Phase 1 training at ATR (Army Training Regiment) Pirbright between Feb and Jun 02. Recruits were followed up for occurrence of AKP during the course of their training and measures of occupational outcome were recorded.

All recruits underwent a standardised training program. This consisted of approximately 7 forty-minute sessions of specific exercise sessions per week, aimed at improving cardiovascular and muscular endurance and strength. A similar amount of time was spent doing military exercises such as loaded marching and tabbing.

At the beginning of training, recruits underwent an entry medical and were asked about any present or previous symptoms of AKP. This was corroborated with their medical records (Fmed4).

Case capture

AKP cases were captured through self-presentation of pain at the ATR medical centre. Recruits were initially seen by a medical assistant, where a history was taken and symptoms were listed. Those cases that interrupted more than 2 days of training, were also seen by a unit medical officer (MO). A case was defined as the symptom complex AKP if the following criteria were met: 1. Pain around the anterior aspect of the knee; 2. Insidious onset and 3. No evidence of trauma (e.g, falls, twists). The literature on AKP is complicated by different definitions for conditions such as patellofemoral pain syndrome. The criteria used for this study were made deliberately pragmatic to allow the results to be applicable to standard clinical practice. Attendance at the Medical Centre was registered in a sick book, these were checked each week and medical notes followed up accordingly to ascertain a case. Any notes where an AKP case was difficult to define according to our criteria were followed up by communication with either the GP/MO, physiotherapist or recruit.

In order that a repeatable and precise diagnosis could be given, a specialist AKP Clinic was also instigated (Author AR) for GPs to refer all cases to. The intention was to gain a breakdown of the different diagnoses that presented as AKP.

Upon leaving the ATR recruits completed a knee pain questionnaire (13). The purpose of this questionnaire was to establish which recruits had symptoms of overuse knee pain during training and had left it unreported. All recruits medical notes and primary care hospital database records were reviewed on leaving Pirbright. Any other lower limb injuries were recorded along with associated dates and training days lost. This information was used to select a lower limb injury group for comparison with the AKP group.

Occupational outcomes

Recruits who were medically discharged (MD) or discharged as of right (DAOR: a voluntary discharge at the request of the recruit) attended the medical centre before leaving the ATR. A nominal role of attendance at these clinics was used to follow up recruits with these outcomes. The time taken to complete training was collected to ascertain which recruits had been held back in training or back-squadded (BS). This gives a measure of training efficiency.

Comparisons and Analysis

The incidence of AKP and 95% CI was calculated. This was also broken down by gender. Individuals who were still in training were not included in the denominator of the incidence calculations due to incomplete injury surveillance.

The following comparative groups were formed: 1; AKP Group: Cases that presented to the medical centre according to our inclusion criteria. 2; Remaining Population (RP): All recruits who didn't present to the medical centre with AKP, this group was formed to gain an appreciation of the baseline occupational outcomes. 3; Other Lower Limb Injury (LLI): Recruits that sustained another lower limb injury as reported either in the medical notes and/or on the Medical Centre database. The purpose of this group was to give an indication of the impact of AKP compared with the combined average of other lower limb injuries. For the occupational outcome data, the following comparisons were made: AKP vs RP and AKP vs LLI. Proportions and 95% CIs with each occupational outcome were calculated for each group. These were compared using the Fishers Exact test. Alpha was set at the 5% significance level. The denominators for the back-squadded rates (Table 3) do not include those individuals who discharged as of right, were medically discharged or discharged for another reason. However, if the individual was back-squadded before a DAOR or MD outcome, they were included in the numerator. The denominator for the MD and DAOR rates (Table 3), do not include those with incomplete injury surveillance i.e., still in training at the end of data collection.

Results

The study sample represents approximately 30% of the recruit intake to ATR Pirbright in the year 2002. This sample was typical of military recruits with a young positively skewed age distribution, and heterogeneous physical characteristics reflecting varied anthropometry (Table 1). Eighty-two recruits (63 male, 19 female) were still in training and omitted from the incidence data. Thus complete injury surveillance was

Table 1. Age (yrs), height (m), and weight (kg) descriptive statistics of the cohort.

	N	Median age (IQR)	Mean height (sd)	Mean weight (sd)
Male	960	19.4 (17.2-22.2)	1.78 (0.06)	72.4 (10.2)
Female	48	18.7 (17.0-22.1)	1.67 (0.06)	62.6 (7.8)
ALL	1008	19.4 (17.7-22.2)	1.78 (0.07)	71.0 (10.3)

Table 2. Incidence of AKP as presented to the Medical Centre and GP, and by Gender.

	Cases/ n*	Incidence (%)	95% CI
Total AKP Presented to Medical Centre	81/ 926	8.75	6.93 – 10.57
Total AKP seen by MO	42/ 926	4.54	3.20 – 5.88
Males seen by MO	38/ 897	4.24	2.92 – 5.55
Females seen by MO	4/ 29	13.79	1.24 – 26.34

The denominator does not include recruits still in training (held back) at the end of data collection (n=82).

available for 93.4% of males and 60.4% of females.

Eighty-one (8.75%) recruits presented to the medical centre complaining of AKP. Forty-two (51.9%) of these were referred to a GP/MO (Table 2). Other cases were put on restricted duties (eg; no marching/sport) for up to 2 days and did not return to the medical centre, implying that either their symptoms had receded or they managed to continue training without further consultation. Upon leaving ATR Pirbright, an additional 77 subjects reported AKP in the knee pain exit questionnaire that did not present to the Medical Centre. Therefore, the combined incidence of knee pain reported in the questionnaire and self reported to the medical centre was 17.0% ((81+77)/926; 95% CI: 14.6 – 19.5).

Two out of eleven (18%, 95% CI: 0 – 41%) recruits with previous symptoms of AKP became symptomatic during training. Five persons were medically discharged as defective on enlistment, accounting for these results means that 91% (95% CI: 85.2 – 97.5) of the AKP incidence were first onsets of AKP.

The median days lost for a case of AKP was 3 (inter quartile range (IQR): 3 – 5 days). Although a similar median, this was significantly greater than the LLI group (median: 3 days; IQR: 2-4 days, $p<0.01$, Mann Whitney U).

Those who suffered AKP were more likely to be back squadded or medically discharged than other recruits ($p<0.05$) (Table 3). The DAOR rate in the AKP cohort was lower than the LLI and RP group, although not significant (Table 3).

Of the nine recruits medically discharged from the AKP group, one was MD for a reason other than AKP, three were injured during training and five reported as injured on enlistment. During the time frame of the study, 30 recruits were medically discharged, eight of these discharges (26.7%) were due to AKP.

Unfortunately, due to logistical problems in following up recruits involved in a heavy schedule of military training, the referral rate for the specialist AKP clinic was only slightly more than 50%. However, in recruits who were referred to a GP and/or the AKP clinic (n=42), the most common cause of AKP was patellofemoral pain syndrome (PFPS) which occurred in more than 50% of cases. The other common diagnoses were illiotibial band friction syndrome (21%) and patellar tendinitis (19%).

The majority of AKP cases presented within the first 4 weeks (Figure 1). Figure 1 also shows a bimodal distribution of injuries

Table 3. The proportion of subjects within each comparative group that were MD, DAOR and BS. Hypothesis tests compare the AKP group to the whole RP and to the LLI subgroup of RP.

	Group	Cases/ n*	Proportion	95% CI	P-value vs AKP
MD	AKP	9/ 72	0.125	0.049 – 0.201	
	RP	21/ 845	0.025	0.014 – 0.035	<0.001**
	LLI	6/ 195	0.031	0.007 – 0.055	0.006**
DAOR	AKP	4/ 72	0.056	0.003 – 0.108	
	RP	101/ 845	0.120	0.098 – 0.141	0.122
	LLI	23/ 195	0.118	0.073 – 0.163	0.171
BS	AKP	20/ 68	0.294	0.186 – 0.402	
	RP	134/ 804	0.167	0.141 – 0.192	0.012**
	LLI	35/ 162	0.216	0.153 – 0.279	0.236

See analysis section and paragraph 1 of results for an explanation of numerator and denominator
****Significantly different than AKP group (p<0.05)***

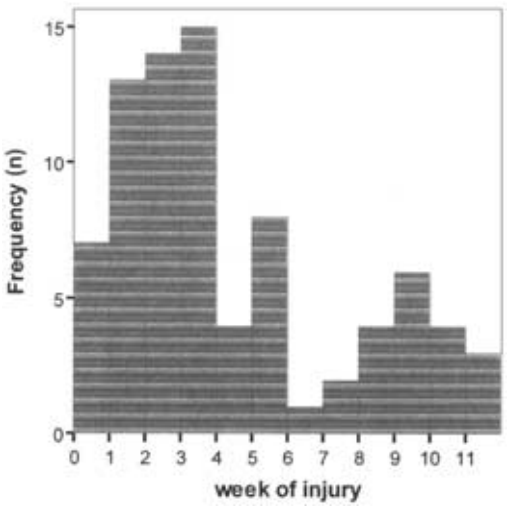

Fig 1. Histogram of week of AKP injury presentation.

by week of occurrence with modes at week 4 and 10.

Discussion

Incidence and occupational outcome data have been presented from a prospective cohort study into AKP. The sample used in this study is similar to that described in other military studies (2) and as such it is considered that the results can be generalised to the recruit population.

The incidence of AKP (8.75%) fell within the range reported in previous military studies (2,4-6). Differences between the incidence reported in this study and the 15% reported in a previous study (6) may be partly explained by differences in the case capture method. Milgrom and co-workers (6) used a screening method every two weeks as opposed to self-reporting. It is suspected that this latter method may generate more cases, in fact, the incidence of recruits suffering some form of AKP was actually 17% when we surveyed each recruit at the end of training. In designing this study, it was considered important to obtain data that were clinically meaningful, thus cases of AKP where training continued without interruption were not considered important. It may also be difficult to clinically separate the 'questionnaire' cases from general aches normally associated with exercise, which may create some false positives. However, AKP does seem to affect a large proportion of recruits in basic training, which supports anecdotal evidence and medical discharge data (12). Seasonal effects may have an influence on injury rates, possibly as a result of different training surfaces and demographic differences in recruit intake. This study took place from February to August, encompassing winter and summer so it is expected that any potential seasonal variation would be caused predominantly by demographics. This effect is also likely to be small considering the age and anthropometric similarity of our sample with other reported military samples.

Although it is generally reported that the female incidence of AKP can be as much as two to three times greater than males (14), there were too few females in this study to draw any definitive conclusions. More than a third of the female cohort had incomplete injury surveillance, a further study on the incidence of AKP in females is thus recommended.

The majority of AKP came from recruits who had no previous history of AKP. Although recruits may have been unwilling to disclose previous symptoms during their entry medical, these new cases do represent a large proportion of the incidence. Furthermore, since only two (18%) of the recruits who reported previous symptoms of AKP became symptomatic during training, it does suggest that AKP sufferers can have enough relief of symptoms to undergo a strenuous training program.

Most injuries were sustained in the first few weeks of training. Although similar findings were found in a stress fracture study (15), Milgrom *et al* (1991) (6) fournd AKP injuries were distributed evenly throughout military training. Differences in findings between the Milgrom study (6) and our data may be due to the different case capture methods employed. The early onset shown in our data is possibly expected, since although the training program is graded, some individuals experience a step in training load due to low pre-enlistment activity levels and low physical fitness (16). Progression of training load and training content are external factors that can be manipulated and although there is little research on the effects of specific exercise interventions to prevent injury, the results are encouraging. For example, one study demonstrated a reduced risk of ankle injuries in soccer players by propioception and performance training on a frequent basis (17).

While the TDL data for the AKP group suggest that the impact of AKP on occupation is slight and most cases are mild, an examination of medical discharges indicates that at least in a large minority of sufferers, their symptoms resulted in attrition. Furthermore, our data showed this accounted for more than a quarter of all medical discharges. AKP cases also took longer to train, thereby having an impact on training efficiency. However, to gain a true extent of severity of AKP, a long-term follow up of cases is required. One previous study has reported results from a 6-year follow-up of Israeli Army recruits and found continued symptoms at 6 years in 50% of original cases and severe symptoms in 8% (18). This study also showed that absence of AKP early in a training program did not necessarily mean immunity from AKP in the future. These findings and results from our study suggests that the prognosis and aetiology amongst AKP sufferers in this population is varied

and thus one should be careful about formulating policy relating to a population with such variance of outcome.

In addition to the impact of AKP on recruit training, it is logical to assume that this will have a significant impact on the health of the Army in general. This is supported by the waiting list for patellar pain treatment and clinics at the Defence Medical Rehabilitation Centre and data from 'tri-service' physiotherapy admissions which reports 2.8% of the Armed forces population seeking physiotherapy treatment for knee pain. Research into the efficacy of non-operative treatment for AKP and PFPS in particular has also shown encouraging results. A previous study showed improvements and relief of AKP after only 2-4 weeks of eccentric muscle training (19). Furthermore, Kannus *et al* (1993) (20) found that younger PFPS patients tend to have better outcomes from rehabilitation and in a review of clinical trials on PFPS non-operative therapy, it was concluded that the prognosis is good in new cases of PFPS (11). Given that the majority of AKP in recruits seems to be new cases, and are from a young population, it is intuitive to hypothesise that non-operative treatment could improve the clinical outcome in this population.

Ideally one trained observer would have diagnosed all AKP cases as was intended, however this study used population-based methods, and it is logistically difficult and expensive to set up such pure case capture techniques in studies of this size. This weakness is offset to some extent by the large sample size, which improves the certainty of the confidence intervals.

Conclusion

The total Army recruit intake was 13,783 for the last financial year (2003-04), thus an AKP incidence of 8.75% could result in a high number of cases in absolute terms. While the prognosis appears generally good in a large proportion of AKP sufferers, this high incidence has an impact on overall training outcome and may have possible long-term ramifications on the health and fitness of the Army. Further work should examine methods of reducing the disease burden of AKP in the Army and as such should address the areas of aetiology, prevention and treatment. A systematic and comprehensive approach to AKP research is more likely to produce the desired outcomes of injury rate reduction, reduced occupational attrition and improved injury management.

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